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MAR 24 2005

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Ms. Sandra Johnson
U.S. Environmental Protection Agency, Region VIII
Technical Enforcement Program, 8ENF-PT
999 18th Street, Suite 300
Denver, Colorado 80202-2466

Mr. Dave Akers, Manager
Colorado Department of Public Health and Environment
Water Quality Protection Section, WQCD-PWQPR-B2
4300 Cherry Creek Drive South
Denver, Colorado 80216-1530

Dear Ms. Johnson and Mr. Akers:

Enclosed is the Rocky Flats Environmental Technology Site (Site) Annual Ammonia Study Report for Calendar Year 2004. The renewed National Pollutant Discharge Elimination System (NPDES) Permit, effective October 27, 2000, requires that the permittees "summarize the status of the Big Dry Creek ammonia studies and present relevant findings and recommendations on the further monitoring or possible control of ammonia loading from RFETS." The enclosed report addresses this requirement.

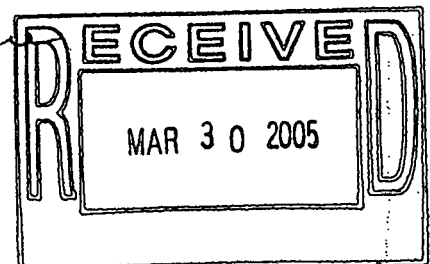
I certify under penalty of law that this document and all enclosures were prepared under my direction or supervision in accordance with a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

If you have any questions or desire additional information on this matter please contact John Stover, of my staff, at (303) 966-9735.

Sincerely,

**Joseph A. Legare, Director
RFPO Project Management**

Enclosure



ADMIN RECORD
SW-A-005060

Reviewed for Addressee
Corres. Control RFP

3/30/05 *LC*
Date By

Ref. Ltr. #

JOE ORDER #
5400

Ms. Sandra Johnson
Mr. Dave Akers
05-DOE-00165

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MAR 24 2005

cc w/Encl.:

J. Cable, K-H

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**THE 2004 RFETS AMMONIA STUDY:
LONG TERM EVALUATION OF NUTRIENTS IN SURFACE WATER AT
ROCKY FLATS AND THE IMPACT ON DOWNSTREAM WATERS**

1. INTRODUCTION

1.1 Background

The Rocky Flats Environmental Technology Site's (RFETS or Site) National Pollutant Discharge Elimination System (NPDES) permit was renewed in 2000. Among the requirements in the renewed permit is a provision to conduct an ammonia study in surface waters at the Site and evaluate the impact on downstream waters. The requirement arose from Colorado Water Quality Control Commission (CWQCC) action in 1995 in which un-ionized ammonia was removed as a water quality standard from a portion of Walnut Creek.

Previous reports on the ammonia study presented the results of ammonia and nitrate analyses at RFETS monitoring point GS03, located at the intersection of Walnut Creek and Indiana Street on the eastern boundary of Rocky Flats. In the 5 years of the Ammonia Study, the 85th percentile levels of ammonia and nitrate remained below applicable water quality standards. Segment 1 of Big Dry Creek had similarly low levels of these nitrogenous compounds except for those monitoring locations immediately downstream of the municipal wastewater plants, where nitrate levels have been observed above 10 mg/L. The 2004 results presented here show that there continues to be little impact to downstream waters from ammonia and nitrate leaving RFETS in Walnut Creek.

1.2 Scope of the Ammonia Study

Water quality samples are collected specifically for this study at Walnut Creek and Indiana Street, and analyzed for total ammonia and nitrate plus nitrite. Data from other monitoring activities are used to evaluate known sources of nitrogen species and general site conditions upstream of GS03. Biological data, from sampling activities both on-site and in the main stem of Big Dry Creek, are examined for evidence of impacts of nutrients on habitat or biota. The City and County of Broomfield monitors RFETS discharges for chlorophyll a, a measure of algal levels. Those data are included here for comparison to the nutrient levels.

According to the NPDES permit, the purpose of this study is to help determine "the appropriate effluent limitations on ammonia from the [RFETS] sewage treatment plant in order to meet appropriate water quality standards in downstream reaches."

1.3 Nutrient Criteria

In previous reports, the potential development of water quality criteria for nutrients was discussed, based on guidance issued by the Environmental Protection Agency (EPA) which calls for states to begin drafting nutrient criteria development plans. Targeted parameters are nitrogen species and phosphorous. The state's process is still in review, as of August, 2004 (CDPHE 2004)

In September 2002, the Colorado Department of Public Health and Environment (CDPHE) published a plan for the development of nutrient criteria (CDPHE 2002), which describes the current vision for this process. The plan reports that the focus of nutrient criteria in Colorado will be on the relationship between nutrient levels and algal populations, the critical measurement of which is analysis for chlorophyll a. The state intends to use a concept of "expected conditions" instead of the more often described "reference conditions" by which biological assessments are conducted. Another variation that the state will follow is the use of an alternative system to the eco-region approach proposed by EPA. Such an alternative approach was identified as allowable by EPA as noted in the 2001 RFETS Ammonia Study. The "expected condition" approach is currently being evaluated to support changes in the state's aquatic life use classifications.

Finally, the state will initially focus its limited resources on mountain streams. It is hoped that the results of regional pilot studies will help shape the approach to nutrient criteria. The state's position is that "it doesn't seem worthwhile at this point to pursue a pilot to address cause/effect relationships in the plains." Unfortunately, the results of this ammonia study will probably not be included in any studies aimed at developing nutrient criteria. The CDPHE plan currently anticipates that nutrient criteria will be ready for consideration by the Water Quality Control Commission in 2010.

2. METHODS

Samples for total ammonia and nitrate plus nitrite were again collected at GS03 and analyzed at a contract laboratory. The field parameters, temperature and pH, were measured at the time of sample collection. Using the total ammonia, temperature and pH data, the portion of ammonia in the un-ionized form was calculated. Only the un-ionized results for monitoring at GS03 are reported here.

Samples were collected daily during periods of pond discharge. As reported in previous studies, the schedule of monitoring was reduced to week days only during periods of discharge. In calendar year 2004 this resulted in the collection of 49 samples. The results for 2004 have been added to the ammonia study database for Walnut Creek, and the 2004 results are presented below as well as the cumulative results to date in the study.

To supplement the monitoring conducted specifically for this study, results from other monitoring efforts are reviewed and included here for comparison purposes. A key element of the study has been to examine the sources of ammonia and nitrate plus nitrite to Site waters. The RFETS wastewater treatment plant (WWTP or B995) was the only source of ammonia upstream of GS03, while nitrate was released from two known sources, the WWTP and the Solar Pond Plume in North Walnut Creek. Data from these sources are presented and discussed.

Biological monitoring was not conducted on-site in 2004. In previous years, biological monitoring was conducted to coincide with the same studies in the main stem of Big Dry Creek. In the most recent report, the results of the biological monitoring included a comparison of two metrics, the Rapid Bioassessment Protocol (RBP) and the Index of Community Integrity (ICI), at locations in Walnut Creek and the main stem of Big Dry Creek. Previous results "generally showed, but not always, that the communities at the downstream sites were more impaired and stressed than at the upstream sites" (Aquatics Associates, Inc. 2002).

3. RESULTS

3.1 Calendar Year 2004 Results

The following sections present a summary of the CY 2004 un-ionized ammonia and nitrate plus nitrite data sets and the basic statistics.

3.1.1 Un-ionized Ammonia

For all samples collected in the 2004 monitoring period, the minimum, maximum and average concentrations and the 85th percentile value of un-ionized ammonia are reported in Table 1.

Table 1 – Calculated Un-ionized Ammonia Results for 2004

Summary of Ammonia Results, mg/L	
MAXIMUM	0.32
MINIMUM	0.00
AVERAGE	0.03
85th Percentile	0.048
No. of Samples	49

3.1.2 Nitrate plus Nitrite

For all samples collected in the 2004 monitoring period, the minimum, maximum and average concentrations and the 85th percentile value of nitrate plus nitrite are presented in Table 2.

Table 2 – Nitrate plus Nitrite Results for 2004

Summary of Nitrate Results, mg/L	
MAXIMUM	1.90
MINIMUM	0.03
AVERAGE	0.46
85th Percentile	1.12
No. of Samples	49

3.2 CY 2004 Results by Month

The following sections graphically present the monthly averages for un-ionized ammonia and nitrate plus nitrite concentrations at the Walnut Creek and Indiana Street monitoring location.

3.2.1 Un-Ionized Ammonia

Figure 1 presents the monthly average un-ionized ammonia concentration. All results collected in a calendar month were averaged to provide the monthly value.

Figure 1 – Average Monthly Un-Ionized Ammonia at Walnut Creek and Indiana St. CY2004

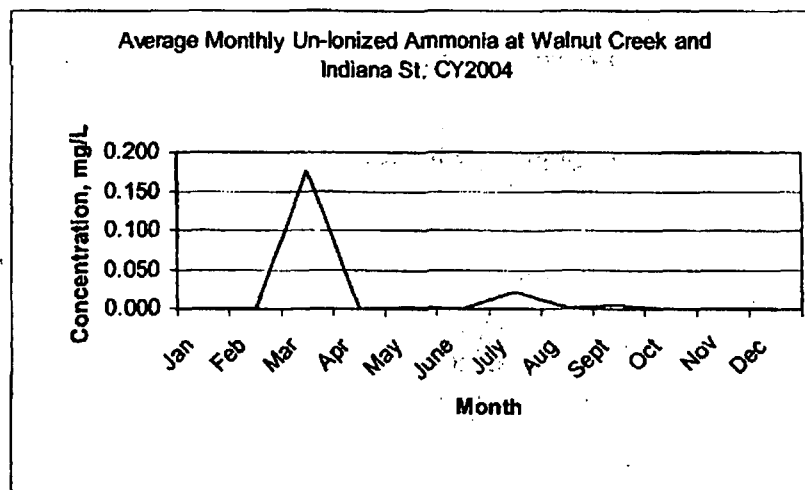
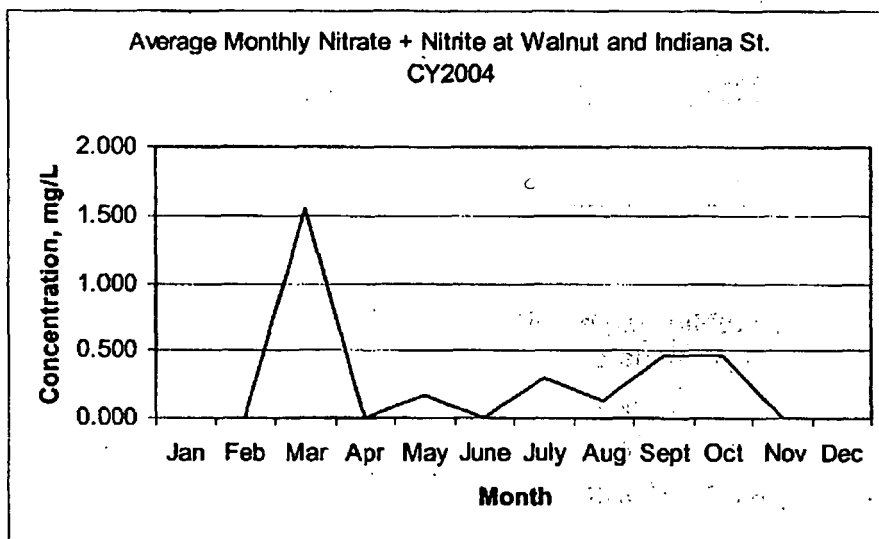


Figure 2 presents the monthly average nitrate plus nitrite concentration. All results collected in a calendar month were averaged to provide the monthly value.

Figure 2 – Average Monthly Nitrate plus Nitrite at Walnut Creek and Indiana St. CY2004



3.3 Cumulative Results

The Ammonia Study of Walnut Creek now has five complete years of results from 287 samples. A summary of the cumulative results is presented below. Nitrate plus nitrite levels continue to meet the underlying standard for water supply (10 mg/L), and the un-ionized ammonia level is below the chronic standard applied to Segment 4a of Big Dry Creek (0.10 mg/L).

Table 3 – 2000 – 2004 Cumulative Results

2000 – 2004 Results	Nitrate, mg/L	Un-ionized Ammonia, mg/L
MAXIMUM	7.40	0.47
MINIMUM	0.00	0.00
AVERAGE	1.26	0.035
85 th Percentile	2.64	0.069
No. of samples	287	

The complete data set for the five year period of this study is presented in the next two figures. There are discernable patterns in the monthly variation of both the ammonia and nitrate concentrations, more notably with nitrate than ammonia. The nitrate concentrations drop off noticeably during the warmer months in all five years of the study. The pattern is less discernable in the ammonia data.

Figure 3 Un-Ionized Ammonia Data Set at Walnut Creek and Indiana St. CY2000 - CY2004

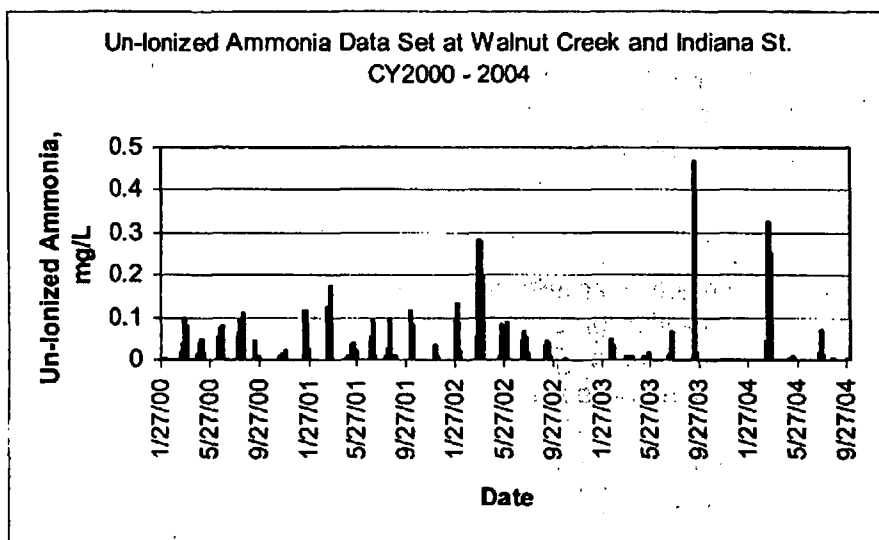
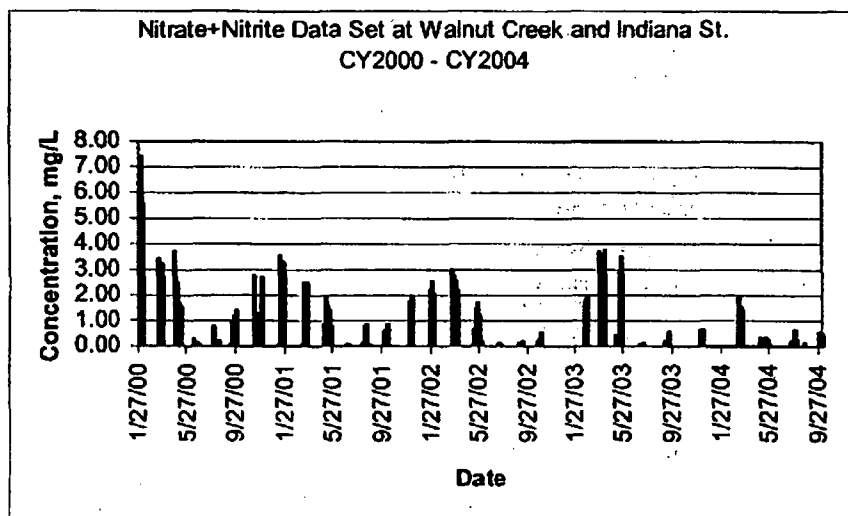


Figure 4 Nitrate + Nitrite Data Set at Walnut Creek and Indiana St. CY2000 - CY2004



3.4 Evaluation of Sources

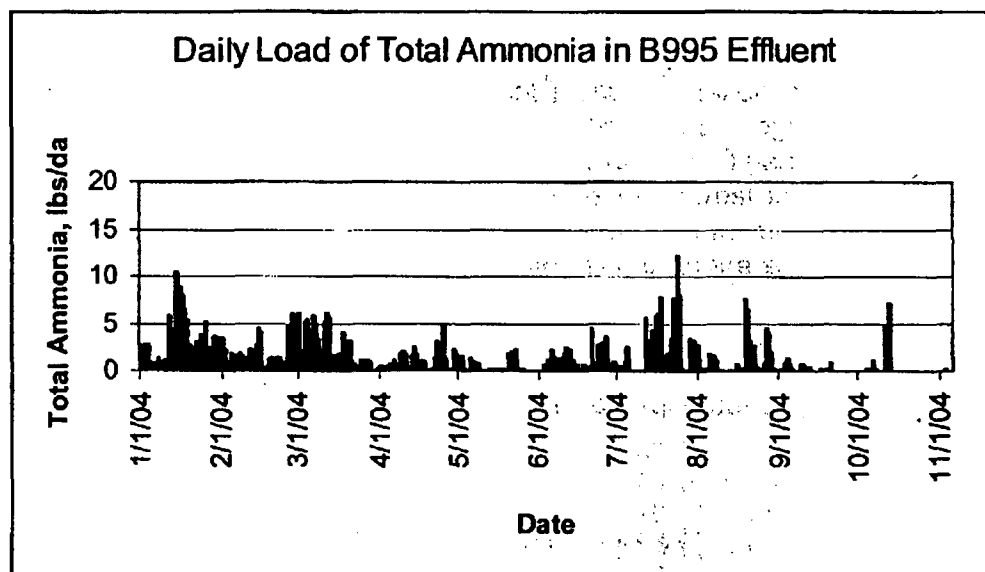
The primary source of nitrogen species in the Walnut Creek drainage are the RFETS WWTP, B995, and, to a lesser degree, discharge or seepage in the Solar Pond Plume area in the North Walnut Creek drainage upstream of GS13.

3.4.1 The Wastewater Treatment Plant

The Rocky Flats wastewater treatment plant was taken out of service in 2004 and demolished. The discharge of the WWTP was regulated by the NPDES permit, which required monthly monitoring of the effluent for compliance with effluent limitations. Of the nitrogen species of interest in this study, there was only one limitation, nitrite. Ammonia and nitrate were monitored for operational purposes, and the results of these monitoring efforts are shown below.

Total ammonia levels were measured in composite samples three days a week on a routine basis. For 2004, the daily results are shown in Figure 5, represented as pounds of total ammonia discharged per day.

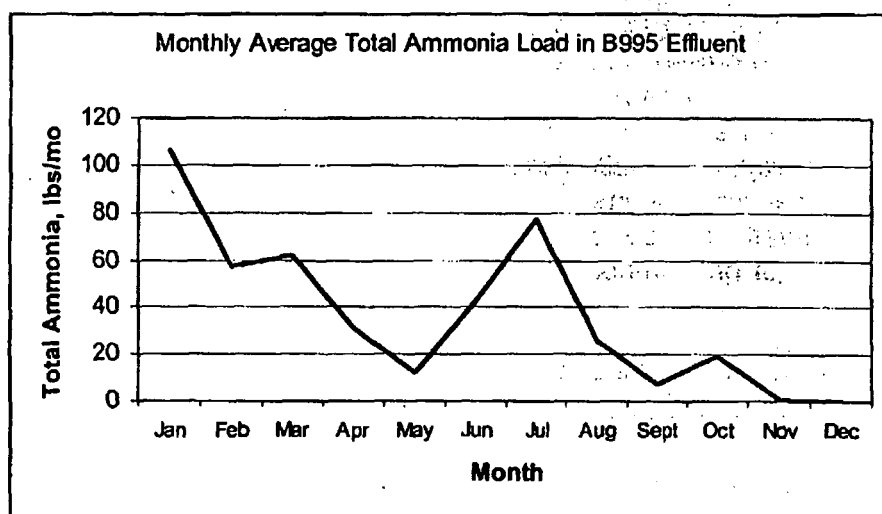
Figure 5 – Daily Load of Total Ammonia in B995 Effluent



It appears that there was a steady decline in total ammonia released from January through May, followed by an increase in July, as shown in Figure 6. For this figure, the daily discharge loads were averaged for all days within a calendar month to determine an average daily load for the month. That value was then multiplied by the number of days in the month to determine the average monthly load. It should be noted that this approach equates week-end days with week days while it is known that there is substantially less flow during week-end days at the RFETS WWTP. However, for comparison purposes, the slightly elevated estimates of ammonia and nitrate loads do not have an impact on the assessment of this source and its role in contributing to the levels observed at GS03.

By this same method, the load of total ammonia from the WWTP in 2004 was 443 pounds, 257 pounds of which were discharged in the first 4 months of the year. The annual load for 2004 is 17% lower than 2003 and 54% lower than 2002.

Figure 6 – Monthly Average Load of Total Ammonia in B995 Effluent



In contrast to the total ammonia levels, nitrate plus nitrite appears to have a lower load in the early part of 2004, as shown in Figures 7 and 8, which present the daily and average monthly loads, respectively, calculated in the same manner as the ammonia loads as described above.

Figure 7 – Daily Load of Nitrate in B995 Effluent

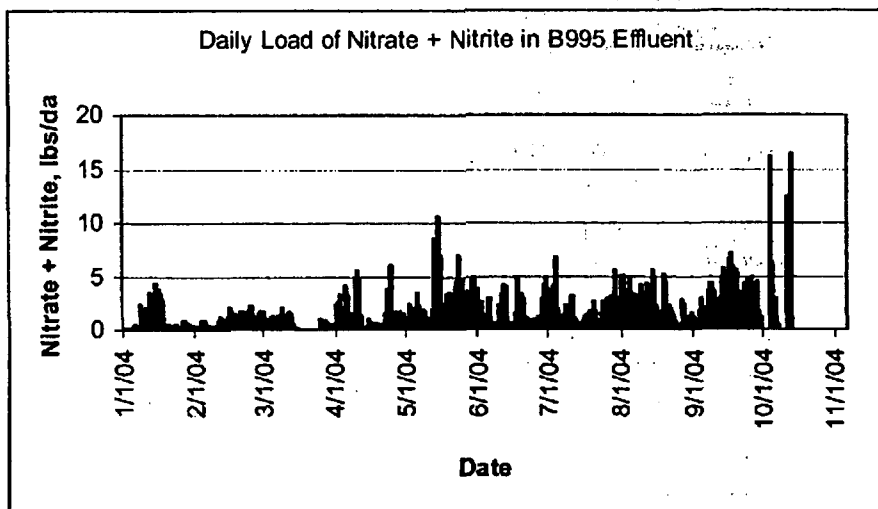
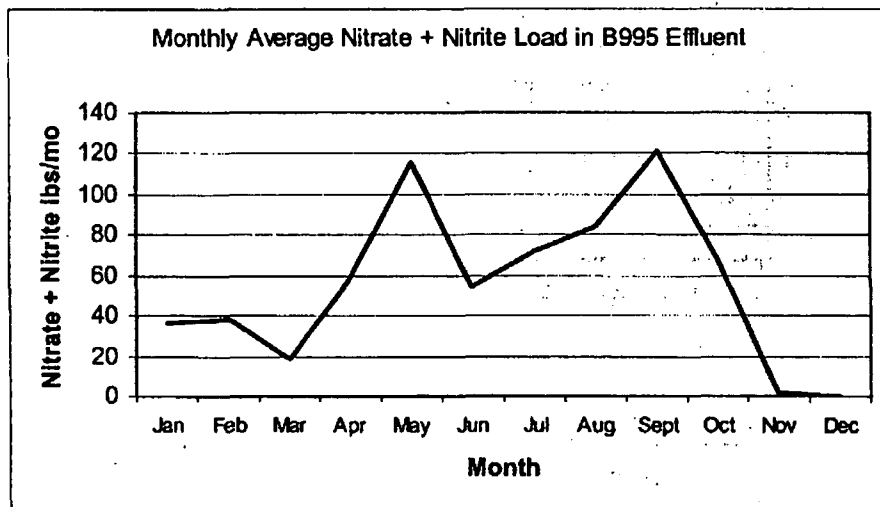


Figure 8 – Monthly Average Load of Nitrate



3.4.2 Solar Pond Plume

One other identified source of nitrogen species to the surface waters of Rocky Flats is the Solar Pond Plume, which impacts the North Walnut Creek drainage. The Solar Pond Plume Project is a remediation effort designed to intercept the flow of the plume and divert ground water to a passive treatment system. As part of this project, nitrate concentrations are measured in North Walnut Creek at

monitoring station GS13 and in Pond A-3. Figure 9 shows the recorded results of nitrate concentrations in North Walnut Creek at GS13 in 2004.

Figure 9 – Nitrate Concentration in North Walnut Creek at GS13 In CY2004

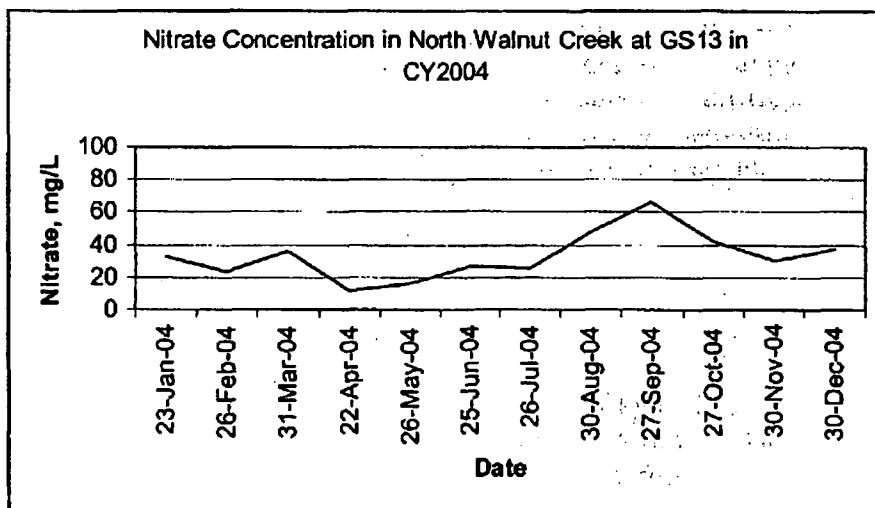
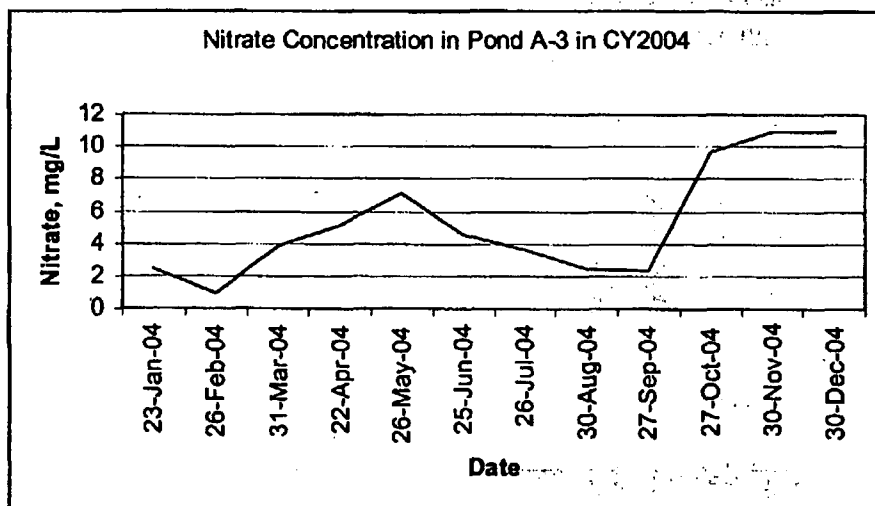


Figure 10 shows the nitrate concentrations in Pond A-3 in CY 2004.

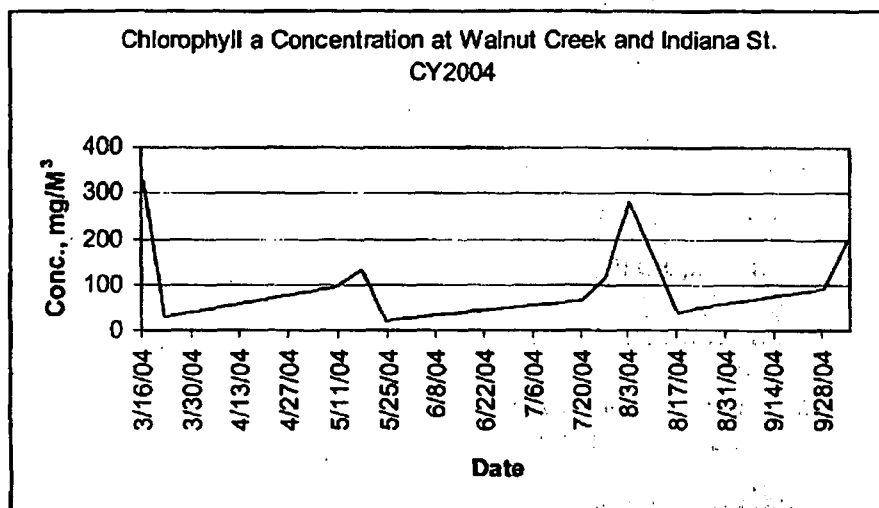
Figure 10 – Nitrate Concentration in Pond A-3 in CY2004



3.5 Potential Relationship of Nutrients and Chlorophyll a

The City and County of Broomfield routinely monitors for chlorophyll a at Walnut Creek and Indiana St. for each pond discharge event at the Site (City and County of Broomfield, 2004). The results of Broomfield's monitoring in 2004 are shown in Figure 11.

Figure 11 – Chlorophyll a Concentration at Walnut Creek and Indiana St. CY2004



A comparison of the 2004 results is made to previous year's results in Table 4.

Table 4 – Chlorophyll a Levels at Walnut Creek and Indiana St.

Chlorophyll a Conc., mg/M ³			
Year	Mean	Min	Max
1999	41	1	306
2000	54	12	148
2001	38	7.7	130
2002	139	2.4	515
2003	96	22.4	248
2004	112.7	21.7	325.5

It should be noted that the chlorophyll a samples are collected only during times of pond discharges from the Site. In 2004, Pond A-4 was discharged two times, May and August; Pond B-5 was discharged five times, March, May, July, September, and October.

3.5 Comparison of Annual Summaries for the Ammonia Study

With the completion of the Ammonia Study, a useful comparison is the annual data for un-ionized ammonia and nitrate at the Walnut Creek and Indiana St. monitoring location.

Figures 12 and 13 present the annual averages and 85th percentile values for un-ionized ammonia and nitrate + nitrite, respectively, at GS03 from 2000 through 2004.

Figure 12. Unionized Ammonia Concentration, mg/L, at GS03 from CY2000 - CY2004

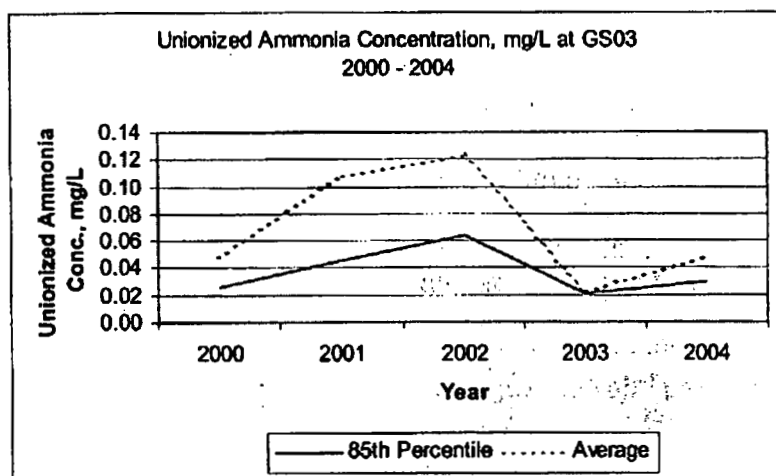
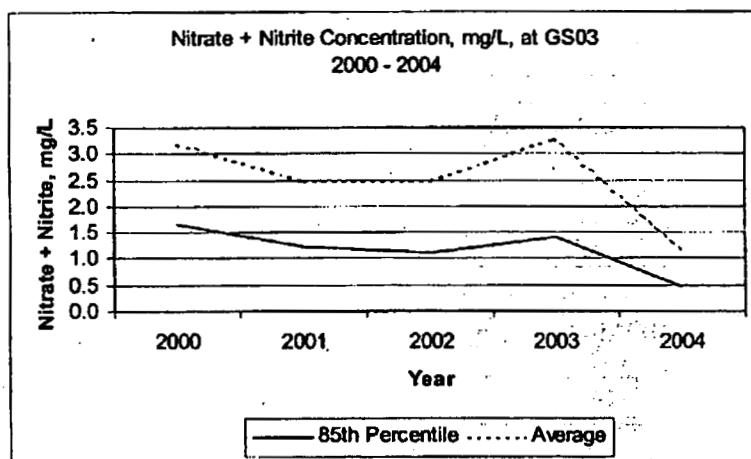


Figure 13. Nitrate+Nitrite Concentration, mg/L, at GS03 CY2000-CY2004



4. DISCUSSION

In 2004, the average un-ionized ammonia level in Walnut Creek at Indiana Street was above the average for 2003 (0.03 mg/L vs. 0.023 mg/L) but below the 5 year average (0.035 mg/L). The maximum value observed in 2004 (0.32 mg/L), was below the maximum of 2003 (0.47 mg/L) which was the maximum value observed during the 5 years of this study. The load of total ammonia to South Walnut Creek from the only identifiable source, the WWTP, was lower in 2004 over 2003, yet the average at GS03 had increased. This is likely due to the pH and temperature conditions, accounting for a greater shift toward un-ionized ammonia in 2004.

The distribution of ammonia at GS03 in 2004 reflects the pattern observed in previous years, showing elevated values of total ammonia generally in the first 4 months. B995 monitoring results (as reported in the monthly Discharge Monitoring Reports) showed higher levels of total ammonia in the discharge for this same period of time. In fact, over half of the total amount of ammonia released from the WWTP was in the first 4 months of the year. Since the WWTP is the only known source of ammonia in the surface waters at RFETS, it is expected that these two data sets should have similar patterns. In 2003, the pattern of ammonia discharge from B995 held true to the pattern—higher levels in the first 4 months, and over half the total load coming at this time. The un-ionized ammonia levels did not follow this pattern, however, and remained low throughout the year with the exception of one high value measured in September.

Nitrate levels in 2004 dropped dramatically compared to previous years. The maximum value in 2004 was 1.9 mg/L, exactly half the maximum value of 3.8 mg/L in 2003. Of the two sources of nitrate upstream of GS03, neither the pattern of the monthly load from the WWTP nor the nitrate concentrations at GS13 match the pattern of nitrate observed at GS03 in 2004.

The low levels of ammonia and nitrate leaving RFETS do not appear to have had any adverse biological impacts downstream of the Site. The latest report on monitoring in the Big Dry Creek watershed (Aquatics Associates 2005), and results from the CY2003 biological evaluation (Aquatics Associates 2004), indicate healthy conditions in Walnut Creek from Rocky Flats to the confluence with the main stem of Big Dry Creek. This work documents the occurrence of rare macroinvertebrates in this reach, indicative of high water quality.

2004 continued the recovery, begun last year, from the severe drought of 2002, with some hydrologic patterns returning to more normal conditions. In 2004, the Site recorded over 16 inches of precipitation for the calendar year. The WWTP discharged approximately 22 million gallons in 2004, compared to 39 million gallons in 2003, 49 million gallons in 2002 and 54 million gallons in 2001 (roughly equivalent). The lower ammonia levels at GS03 in 2003 and again in 2004 reflect

the decreasing discharges from B995. As a result, the 2004 un-ionized ammonia levels in Segment 4b demonstrate that the segment continued to meet underlying standard and supports the current stream segmentation and regulatory structure even with the presence of the wastewater treatment plant discharge. With the demolition of B995, ammonia will all but disappear from this stream segment.

5. REFERENCES

Aquatics Associates, Inc. 2002 Results of the Aquatic Monitoring Program in Big Dry Creek and Walnut Creek 1999 – 2001 December 2002 Aquatics Associates, Inc. Fort Collins, CO

Aquatics Associates, Inc. 2004 Results of the Aquatic Monitoring Program In Streams At Rocky Flats Site, Golden, Colorado 2003 June 2004 Aquatics Associates, Inc. Fort Collins, CO

Aquatics Associates, Inc. 2005 Results of the Aquatic Monitoring Program in Big Dry Creek and Walnut Creek 2002 – 2003 March 2005 Aquatics Associates, Inc. Fort Collins, CO

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CDPHE 2004 Annual Report to the Water Quality Control Commission Fiscal Year 2003 – 2004 October 1, 2004.

City and County of Broomfield 2003 Rocky Flats Environmental Monitoring Report January – March 2003, April – June 2003, July – September 2003, and October – December 2003, City and County of Broomfield Environmental Services Division